ēlin DIVISION — CALIFORNIA INSTRUMENTS CORPORATION

3511 MIDWAY DRIVE / SAN DIEGO, CALIFORNIA 92110

MP MASTER

MA28102

INSTRUCTION MANUAL

Model MK-150-15

Serial 4580-5

INSTRUMENT
CENTER

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ONE YEAR WARRANTY

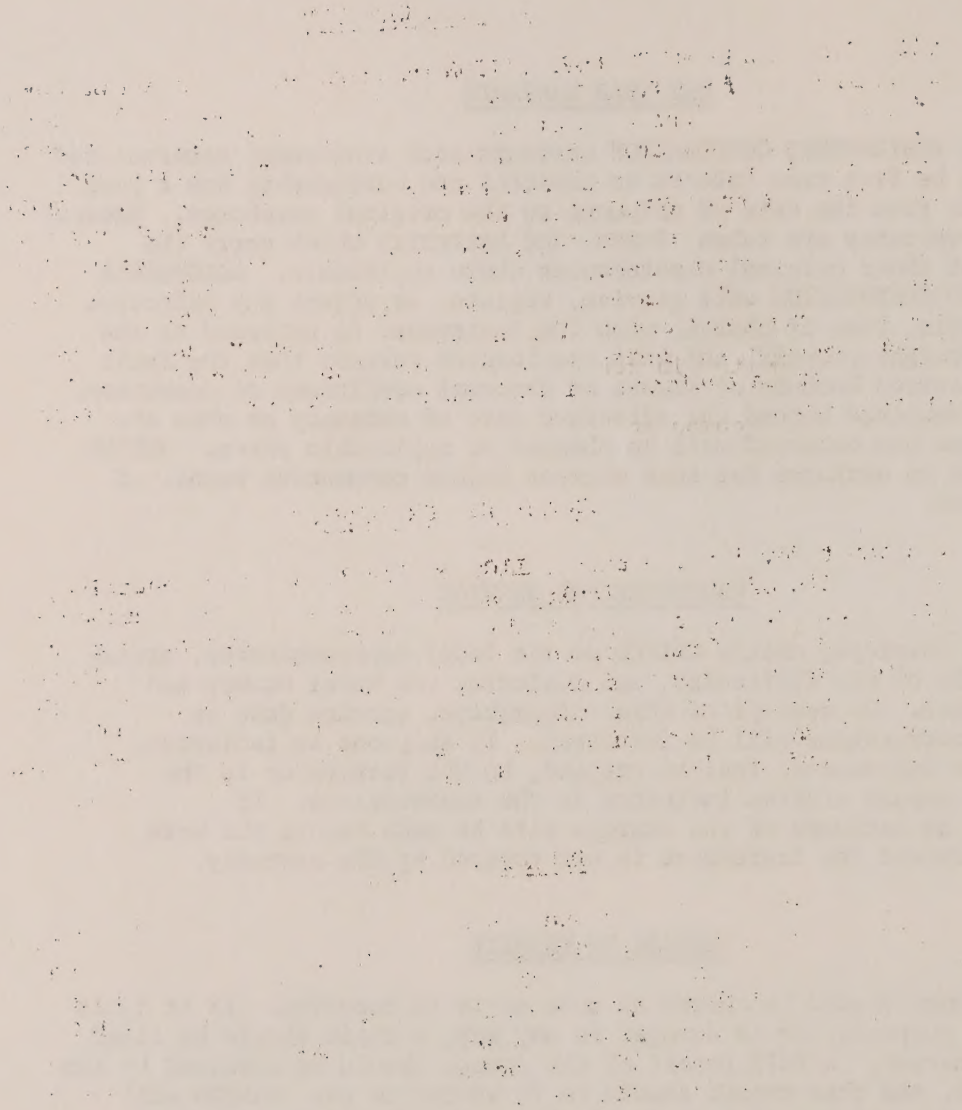
CALIFORNIA INSTRUMENTS CORPORATION warrants each instrument manufactured by them to be free from defects in material and workmanship for a period of one year from the date of shipment to the original purchaser. Excepted from this warranty are tubes, fuses, and batteries which carry the warranty of their original manufacturer where applicable. CALIFORNIA INSTRUMENTS CORPORATION will service, replace, or adjust any defective part or parts, free of charge, when the instrument is returned to the Company, freight prepaid, and when examination reveals that the fault has not occurred because of misuse or abnormal conditions of operation. Equipment repaired beyond the effective date of warranty or when abnormal usage has occurred will be charged at applicable rates. CALICO will submit an estimate for such charges before commencing repair if so requested.

PROCEDURE FOR SERVICE

If a fault develops, notify CALICO or its local representative, giving full details of the difficulty, and including the model number and serial number. On receipt of this information, service data or shipping instructions will be furnished. If shipment is indicated, forward the instrument, freight prepaid, to the factory or to the authorized repair station indicated in the instructions. If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the warranty.

DAMAGE IN TRANSIT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to us. CALICO will advise the disposition to be made of the equipment and arrange for repair or replacement. Please include model number and serial number when referring to the instrument.



SPARE PARTS ORDERING INFORMATION

In order to provide our customers with prompt service on component parts procurement for ēlin equipment, please follow the instructions below.

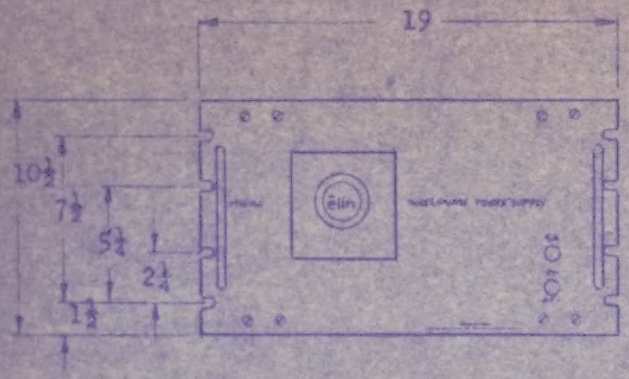
When ordering component parts, DELETE THE LETTER PREFIX that may appear in the ēlin part number, EXCEPT in the case of TRANSFORMER orders.

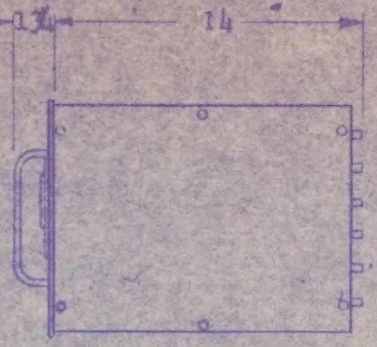
Ordering information must include the ēlin part number and a description of the part.

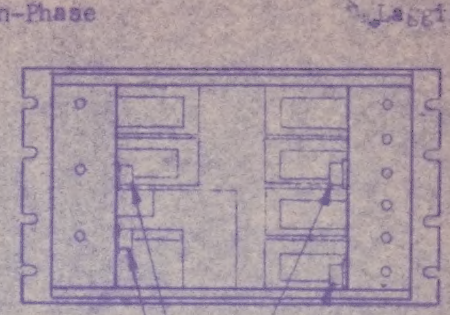
Example: ēlin part number 73721, potentiometer, 25 ohms, 2 watt.

If possible, include the manufacturer's name and part number as well as the model number and serial number of the instrument.

Example: ēlin part number 73721, potentiometer, 25 ohms, 2 watt, Clarostat 43C2, for Model RK-102, serial number 0036.







Output (Lower)
Output (Upper)
Input 115V
Ext. Sync.
(When fitted)

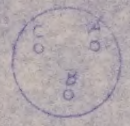
Input Voltage:	115 V ± 10 V
Input power:	225 W
Output Voltage #2	130 V ± .1 %
Output Voltage #1	110/120V ± .1%
Output Frequency:	400 C/S ± .1 %
Output Regulation:	.1 % L to L
Output Distortion:	.2 % L to L
Load Power Factor:	30 %
Sync. Input Voltage:	10 V
Front Panel Color:	Standard
Schematic Number:	B77110
Weight	56 Lbs.

TUBE COMPLEMENT

6 ea 7355
3 ea 6AN8
2 ea 5ARL
1 ea 6XL
1 ea 6AU6
1 ea 6CM6

Power
MS 3102A-16-10P

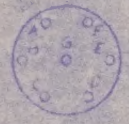
A. 115 V
B. Ground
C. 115 V



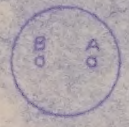
Lower Conn. #1

A	Neutral	
B	In phase	110V L-L
C	120° Leading	110V L-L
D	120° Lagging	110V L-L
E	In phase	120V L-L
F	120° Leading	120V L-L
G	120° Lagging	120V L-L

Output
MS 3102A-16S-1S



Sync. Input
MS 3102A-14S-9P



A. Input 0°
B. Input 180°

Upper Conn. #2

A	Neutral	
B	In phase	130V L-L
C	120° Leading	130V L-L
D	120° Lagging	130V L-L

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SERIAL NO.

SPECIFICATION,
THREE PHASE POWER SUPPLY

SCALE: 1/8	APPROVED BY: B. Wurda	DRAWN BY GJC
DATE 31, JAN '61		REVISED

Elin division — INTERNATIONAL ELECTRONIC RESEARCH CORP.
135 W. MAGNOLIA BLVD., BURBANK, CALIFORNIA

MODEL: MK-150-15

DRAWING NUMBER A86110

OPERATING INSTRUCTIONS

The model T-156 is a three phase power supply utilizing standard ēlin circuitry for three separate precision power oscillators with a common driver oscillator, all mounted on a standard 10-½" rack panel.

Viewing from the front, there are two separate chassis assemblies; On the left the 120° lagging (upper) and 120° leading (lower) power oscillators; the right hand housing the in-phase oscillator (upper, the driver oscillator (lower rear) and power supply (lower front).

Power input (117V approximately 250W) is fed to a 3-pin connector, AN3102A-16S-1S, which is for WTE connection.

There are four separate oscillators in the T-156, and each uses, essentially, the same circuitry as follows:

> The ēlin oscillator features constant output voltage under varying line and load conditions; virtual absence of harmonics, noise and hum, and a high degree of frequency stability. These desirable features are obtained through the use of a high Q, LC tank circuit in the frequency determining network and a unique R.M.S. sensitive bridge circuit located in the feedback loop.

THEORY OF OPERATION (Refer to schematic diagram)

A high Q toroidal transformer tuned by silvered mica capacitors and a small variable trimmer capacitor determines the frequency of each oscillator. The fixed capacitor network is selected to give the correct output frequency after the trimmer is adjusted to approximately the center of rotation. Adjustment of the trimmer gives precise settings of frequency over a limited range. Frequency stability over normal laboratory ambient temperature range is maintained through the use of the stabilized core of the toroid and the low temperature coefficient of the tuning capacitors. The Q of the toroid is maintained at a high value because of the high input impedance of the power amplifier and the isolation of the feedback from the output by the use of the ēlin 'Super-Regulation' circuitry. (See below)

The feedback winding of the 'Super-Regulation' loop provides about 1V volts of feedback to the R.M.S. bridge circuitry to compensate for line and load change. The R.M.S. sensitive bridge B-1 circuit is composed of a special ōil-sealed precision resistor and a selected non linear element.

The bridge continuously monitors the output of the oscillator and supplies the positive feedback necessary for oscillation. It produces two signals which are added differentially; one that is proportional to the predetermined voltage level at which the oscillator is to operate; the other, an error signal that reflects varying line and load conditions as they may affect the output.

The net effect of these signals appears as the induced voltage at the

secondary of the toroidal transformer which is located in the negative feedback path and tuned to the operating frequency of the oscillator. The Volt Adj. potentiometer provides fine adjustment of the output voltage.

The feedback winding of the 'zero-regulation' loop supplies a negative feedback signal which is mixed with the positive feedback signal from the toroid. This combined signal is fed into the grid of the input tube which is the first stage of a power amplifier. Extremely low distortion and high stability are achieved in this amplifier through the use of 50 to 70 db of negative feedback around the total amplifier. A highly developed output transformer and selected components for internal compensation are required for proper operation of the circuit. The resistor marked R30 ADJ. is preset at the factory to give better than 0.2% regulation using a resistive load; however, to compensate for drop due to current flow in connecting cables, this control can be adjusted to give positive regulation if required.

By this means, although the apparent output impedance of the oscillators when they leave the factory is in the low milliohm range, the output impedance can actually be adjusted to be negative.

MAINTENANCE

Maintenance on the Elin oscillator should be very limited due to conservative rating of components and use of the [illegible] tubes; however, should failure occur, a systematic approach to the problem should be followed. It is recommended that the following procedure be used:

1. The fuse located on the front panel should be checked.

2. Alternating current supplied to the power transformer should be measured to insure that the input power is within the range of 105 to 125 V RMS, 60 to 400 CPS.

3. The tubes should be checked by direct substitution, beginning with the power output stage.

4. DC voltage measurements should be made to determine if all voltages are correct.

5. The grid input of the first amplifier stage may be opened and a signal introduced between grid and ground from an external source. The power oscillator is then operating as an open-loop power amplifier, and ordinary audio amplifier trouble shooting may be employed.

6. If none of the above steps locates the source of trouble, it may be assumed that there are malfunctions in the feedback or regulating circuits.

Correction of malfunctions in these areas should only be attempted by those who are familiar with circuits of this type.

MK-150 [illegible] CIRCUIT [illegible]

Since the MK-150 actually includes four 3-Phase oscillators, the following procedures should be used in the order given:

NOTE: ALL REFERENCES TO POSITION OF COMPONENTS REFER TO THE VIEW FROM THE REAR.

(1) FREQUENCY ADJUSTMENT

The three push button switches located on the chassis are for disabling the sync circuit to the three oscillator sections. This enables the respective oscillator to operate freely for calibration purposes.

With no load connected to the unit, connect a frequency counter between Pins A & D of either output socket and adjust the in-phase oscillator frequency to 400 CPS ± 0.1% by rotating the 'FREQ. ADJ.' control on the upper left hand chassis.

Next, connect the frequency counter between Pins C & D and adjust the 120° leading oscillator with the 'FREQ. ADJ.' control on the lower right hand chassis. Repeat the procedure with the 120° lagging oscillator Pins B & D and the control on the upper right hand chassis.

The driver oscillator can now be checked by re-inserting the output plug and checking the frequency of the 7V output (10V App.) between the pin jack at lower left hand chassis and adjusting the control on the lower left hand chassis.

(2) DRIVER VOLTAGE ADJUSTMENT

The output voltage of the driver oscillator should be checked as follows: Measure the voltage between the pin jack at lower left hand chassis and adjust the adjacent 'VOLT ADJ.' control to give a reading of 10V ± .01V.

This voltage is the voltage to which the three output oscillators are referenced.

(3) TUBE BIAS SET-UP

The three push-pull output stages each have independent set-up controls located on the chassis toward the rear of each unit.

To check the tube cathode current, two 0-100 ma, DC meters and a

phone plug (Switchcraft #267 or equal) are required, connected as follows:

The following procedure is required for set-up of each of the three oscillators:

Insert phone plug in 'METER' jack.

Adjust output 'VOLT ADJ.' control for nominal voltage output.

Adjust 'BIAS' and 'DC BAL.' controls to give Approx. 35 ma readings on each meter with no load on the output. (Currents should rise to Approx. 50 ma with 16.6W load.)

Check distortion of output; adjust 'AC BAL.' control for minimum distortion.

NOTE: Adjusting the 'AC BAL.' control may affect the balance of the meter readings. If it does, compensate with the 'DC BAL.' control and readjust the 'AC BAL.' control as required for minimum distortion.

Repeat on the other two oscillators.

(4) OUTPUT VOLTAGE ADJUSTMENT

Each power oscillator has an independent adjustment for output voltage and regulation with load variations; but, due to the natural interaction of the three output windings when supplying three phase power, the following set-up procedure MUST be followed:

A. With no load connected, measure each output in turn and adjust the appropriate 'VOLT ADJ.' control to obtain nominal WYE voltage. This can be calculated by dividing the line to line voltage by 1.732.

A. In the no-load configuration, set up the specified line to line voltage between Phases A & B by adjusting the A to B phasing control.

B. In the no-load configuration, set the specified line to line voltage between Phases A & C by adjusting the C to A phasing control.

C. Measure the B to C line to line voltage. It should be as specified. Repeat Steps B & C if the B to C line to line voltage is out of tolerance.

D. With the correct load applied, adjust the regulation controls to achieve the correct line to line voltages under load. Since the regulation and voltage controls do have some interaction, it will be necessary to re-set the voltage controls in the no-load configuration when the regulation controls are varied.

NOTE: Each time the above settings are re-checked, it is possible to improve the accuracy of adjustment; therefore, it is recommended that considerable time be spent on this step.

MK-150-15
BILL OF MATERIAL

1 ea	Pan, Chassis	25601
1 ea	Pan, Chassis	25602
1 ea	Frame	44001-1
1 ea	Frame	44001-3
2 ea	Bracket	16002
1 ea	Panel, Front	04600
2 ea	Plate Cover	67016
4 ea	T-1, 6, 7, 11 Power	2 92110
4 ea	T-2, 5, 8 Output	J 92092
3 ea	T-3, 4, 9 Output (Isolation)	K 92186 See Schematic
1 ea	T-10 Output	J 92165
1 ea	T-12 Power	C 92201
4 ea	BR-1, 2, 3, 4 Bridge	74002
3 ea	V-1, 6, 7 Tube	6AN8
6 ea	V-2, 3, 4, 5, 8, 9 Tube	7155
1 ea	V-10 Tube	6AU6A
1 ea	V-11 Tube	6CM6
2 ea	V-12, 13 Tube	5AR4
1 ea	V-14 Tube	6X4
1 ea	VZ-1 Diode	38000
4 ea	C-1, 16, 20, 30 APC-100	23002
4 ea	C-2, 15, 21, 31 Selected	See Schematic
3 ea	C-3, 14, 22 240 mmf.	22301
9 ea	C-4, 5, 8, 10, 11, 23, 24, 27, 29 .22 mf at 1000V MT2240	22000
4 ea	C-6, 13, 25, 34 40-20-10-10 mf at 475 V	21017
1 ea	C-33 30-20-100 mf at 350/250/50 WVDC	21002

4 ea	C-7, 12, 17, 26 20 mf at 150V	21008
1 ea	C-28 .001 at 600 V	22008
4 ea	R-1, 34, 37, 57 200 ± 10 ohm control	73703
6 ea	R-2, 30, 32, 5, 38, 41 1.2M 1W 5%	73326
3 ea	R-3, 31, 39 330K 1W 5%	73323
4 ea	R-4, 17, 33, 40 2.2K 1W 5%	73309
3 ea	R-6, 28, 43 10K 1W 5%	73311
15 ea	R-7, 10 - 13, 20, 21, 23, 24, 27, 44, 47, 48, 50, 56 47K 1W 5% or 10%	73317
3 ea	12K 10W B.D	73636
3 ea	R-8, 26, 45 35K 10W B.D.	73642
3 ea	R-9, 25, 46 3.5K 10W B.D.	73632
6 ea	R-14, 19, 22, 35, 49, 51 10K 2W Control	73705
2 ea	R-16, 53 500 ohm 2W Control	73704
3 ea	R-18, 52, 67 5 ohm 5W WW Control	73713
3 ea	R-29, 55, 66 25K 2W Control	73706
3 ea	R-15, 36, 42 39K 1W 10%	73204
1 ea	R-54 470 ohm 1W 10%	73202
1 ea	R-58 3.9K ½W 10%	73007
1 ea	R-59 470K 1W 5%	73324
1 ea	R-60 1.5M 1W 5%	73328
1 ea	R-61 1.8K 1W 5%	73307
1 ea	R-62 3.9M 1W 5%	73327
1 ea	R-63 470K ½W 10%	73008
1 ea	R-64 300 ohm 5W B D	73604
1 ea	R-65 300 ohm 10W	73623
1 ea	2K 1W 5%	73308

INSTRUMENT CENTER

3 ea	J-1, 2, 3 Jack, meter	51001
1 ea	J-4 Jack, Pin, Red	51000
2 ea	J-5, 6 MS 3102A-16S-1S	29006
2 ea	P-5, 6 MS 3106B-16S-1P	29506
1 ea	P-7 MS-3102A-16-10P	29007
1 ea	J-7 MS-3106B-16-10S	29507
3 ea	AN-3507-8A	27002
1 ea	Line Cord A.C.	32003
1 ea	S-1 Switch 15 amp	89002
1 ea	F-1 Fuse 5 amp.	45004
1 ea	Fuse Holder	45500
1 ea	I-1 Pilot Lamp #47	54000
1 ea	Pilot Assy.	81008
8 ea	Octal Socket	81002
4 ea	9-pin socket	81001
2 ea	7-pin socket	81000
2 ea	T5-1001-H Base	80006
1 ea	T5-1020H Shield	80003
1 ea	T5-1025H Shield	80004
4 ea	T6-1001H Base	80002
1 ea	T6-1025H Shield	80000
3 ea	T6-1020H Shield	80001
8 ea	T9-2001H Base	80010
8 ea	T9-2027H Shield	80009
14 ea	Tektronic, 11 place	91001
6 ea	Tektronic, 4 place	91000

2 ea	Handles 6"	49002
4 ea	Ferrules	49003
1 ea	Insignia	36000
1 ea	Insignia Holder	40000
1 ea	Insignia Plate	40002
2 ea	Grommets 5/8"	48000

ADDITIONS FOR MK-150-11

1 ea	Switch	89000
1 ea	MS-3102A-14S-9P	29000
1 ea	MS-3106B-14S-9S	29500
1 ea	Isolation Trans.	K 92029
1 ea	AW 3057-6	27006

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REV.	C.N.	DATE	DESCRIPTION	BY	APP.
A	-	5-2-61	C-8, 100μf, 50V. WAS 20μf, 150V. ADDED C-16, 20μf 150V. " R-36, 1K, 1W	J.G.	
B	-	6-14-61	R-13A,B,C & R-20A,B,C WERE 390.	J.G.	
C	329	11-22-62	C92204-1 WAS C92204		

(3)
120° LAGGING

(1)
IN - PHASE

(2)
120° LEADING

2. ** C-1A, B, C & C-3 ARE TRIMMING CAPACITORS. 100μfd IS USED FOR UNDER 10 K.C. 50 μfd IS USED FOR 10 K.C. & OVER.
1. * SEE SPEC. SHEET FOR INPUT, OUTPUT, & SYNC. CONNECTORS.

NOTES:

SERIAL NO.					
PART	VALUE*	PART	VALUE*	R-13 A	
T-2A,B,C		C-10		R-13B	
T-3A,B,C		C-14		R-13C	
C-2A		R-23A		R-20A	
C-2B		R-23C		R-20B	
C-2C		R-34		R-20C	

SCHEMATIC

SCALE: —
DATE: 1-26-61
APPROVED BY: E. Wurster
DRAWN BY: JG
REVISED:

elin division — INTERNATIONAL ELECTRONIC RESEARCH CORP. 1.5 W. MAGNOLIA BLVD., BURBANK, CALIFORNIA

MODEL: MK-150-15 — EFFECTIVE FOR SERIAL NOS. ABOVE 6860-3.

DRAWING NUMBER: C77110 C

06 sr 1670

12X22 PRINTED ON NO. 1000H CLEARPRINT

MP MASTER
MA28102
91864